ATTACHMENT A

Zone Parity: A Non-Statistical Approach to Performance Measurement

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Introduction

The goal of an enforcement program is to ensure compliance with particular rules that are, absent the program, contradictory to the self-interest of the regulated entity. Establishing a set of rules, however, is only the first step in effective enforcement. After the rules are established, the regulated entity will choose whether or not to comply with those rules. Once the regulated firm makes this decision and acts, the enforcement agency must be able to accurately assess whether or not compliance has occurred. Finally, if a determination of non-compliance is reached, a fine or remedy that extracts the entire reward from non-compliance must be assessed. Through an effective enforcement program, the steps of which were just described, the incentives of the regulated entity are altered by making the expected value of non-compliance zero (or negative). With nothing to gain from breaking the rules, compliance is encouraged.

Successful implementation of the pro-competitive elements of the Telecommunications Act of 1996 necessitates the development and implementation of an effective enforcement program. The 1996 Act requires Incumbent Local Exchange Carriers (ILECs) to provide interconnection and unbundled elements to Competitive Local Exchange Carriers (CLECs) in a manner that is "just, reasonable, and nondiscriminatory (§251(c)(3))." Because interconnection and unbundling are extremely important to the development of competition in local exchange telecommunications markets, and because the ILECs have no incentive to promote competition in their presently monopolized local markets, it is imperative that a methodology be established to evaluate whether the ILEC's provision of interconnection and unbundled elements to the CLECs is of sufficient quality to satisfy the "just, reasonable, and nondiscriminatory" standard of the Act and insure the evolution of competition is unimpeded. If the ILEC's service fails to meet this standard (or standards), then penalties should be levied to counterbalance the ILECs' incentive to deter competition through discriminatory service provision.

This document outlines a performance plan that will promote the "just, reasonable, and nondiscriminatory" provision of interconnection and unbundled elements by the ILEC to the CLECs. This methodology is called *Zone Parity* and is based on the *Zone Parity Benchmark.* These benchmarks encourage the ILECs to provide service that is "just, reasonable, and nondiscriminatory" and does so through the use of quality of service standards that are both within the capabilities of the ILEC and of sufficient quality to facilitate the evolution of competition in local exchange telecommunications markets.[1] These service standards, based in many cases on observed ILEC performance, provide CLECs with fixed expectations as to what level of service they should receive from the ILEC and provides the ILEC with certainty as to the level of service required to avoid penalties. Virtually every transaction between a buyer and seller places some bounds on the timing of the transaction, particularly when timing is as an important element of the transaction as in the provision of telecommunications service. If CLECs cannot inform potential customers of expected service provisioning or repair intervals, competition in local exchange markets will be substantially impeded.

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[1] Zone Parity satisfies the "nondiscriminatory" (or parity) standard of the 1996 Act because it is based, when feasible, on observed ILEC performance. Zone Parity establishes a "parity" standard for performance.

The purpose of this document is to outline the fundamental features of Zone Parity and illustrate how the approach readily lends itself to a sensible and effective penalty structure. The document is outlined as follows. First, a description of Zone Parity and the Zone Parity Benchmark are provided in Section II. The Zone Parity Benchmark is a quality of service standard that is the core measurement tool of the performance plan.[2] This discussion includes an application with real world performance data and a comparison between Zone Parity and the LCUG Z-Test. Second, in Section III, a general discussion of how the "output" of the Zone Parity test can be used to establish the level and structure of penalty payments. With Zone Parity it is easy to incorporate per-occurrence and per-measure penalties as well as account for the severity and duration of discrimination in the penalty structure. Conclusions are provided in the final section.

Zone Parity

Zone Parity is based on a few guiding principles. First, the performance plan should ensure that the quality of service provided to the CLECs by the ILEC is "just, reasonable, and nondiscriminatory" and "... at least equal in quality to that provided by the local exchange carrier to itself or to any subsidiary, affiliate, or any other party to which the carrier provides interconnection (§251(c)(2)(C))" as required by the Telecommunications Act of 1996. Second, the measurement procedures of the performance plan should be easy to understand, calculate and interpret and should minimize administrative cost.[3] Third, the plan should be competition- or customer-focused. Reliability is a highly desirable characteristic of telecommunications services and consumers demand expedient repair and provisioning of service, often within specified time intervals. Thus, the formation of reasonable expectations about the quality of service the ILEC will provide CLECs is fundamental to the evolution of competition. Fourth, the measurement procedures should be credible, and based on accurate and reliable data. An ideal measurement procedure allows CLECs to compare (or audit) their own data with that provided by the ILEC.[4] Finally, to the extent possible, the plan should be broadly consistent with the plentitude of underlying principles offered by the various participants to the performance plan proceedings including the ILECs, CLECs, Public Service Commissions, and the Federal Communications Commission. For example, the plan should ensure that a) service that meets the parity standard is not penalized; b) remedies and penalties are based on the severity of discrimination; and c) remedies and penalties are large enough and structured properly to induce compliant behavior.

1. MEASURING ILEC PERFORMANCE

Imagine a situation where the ILEC provides a service to itself at a fixed interval. For example, assume that if dialtone is lost for a residential customer, that dialtone is repaired in exactly 24 hours, every single time it happens. In other words, the mean time to repair is 24 hours and the data has no variation. In this scenario, it is easy to define and measure

[2] Unlike other proposals, the Zone Parity Benchmark can be applied uniformly to all performance measures.

[3] Transparency and simplicity are not excuses for a lack of robustness or accuracy in the measurement procedures. Elements of any plan that can be made less complex without a loss of accuracy, or without a substantial loss of accuracy (subject to a cost-benefit analysis), are preferred.

[4] The CLECs should be able to compare their own internal data on service provision intervals with the provided them by the ILEC. Today, some CLECs must trust the calculations of the ILEC because the existing performance plans are too complex to accurately assess proper penalty payments.

discriminatory service. If the CLEC gets dialtone repair service that is longer than 24 hours, then the service is discriminatory.

What is actually observed is that repair intervals (or any other service) vary from event to event. The average repair interval may be 24 hours, but many customers will get repair in less than 24 hours and some in more than 24 hours. Consider the scenario where dialtone is restored for 70 percent the customers in less than 24 hours and 30 percent in more than 24 hours. If a CLEC's customers had repair intervals of the same distribution -- 70 percent less and 30 percent more than 24 hours -- then the conclusion would be that parity service has been provided. This simple example (loosely) illustrates the fundamental premise of Zone Parity.

Unlike other approaches to performance measurement, but like the vast majority of contractual arrangements between firms that relate to performance levels and remedies, Zone Parity does not rely on statistical tests to assess the relative quality of performance between the ILEC and the CLEC(s). This non- statistical approach greatly simplifies the interpretation of performance measurements and its use of a quality standard is consumer (and thus competition) friendly. While no statistical test is performed, Zone Parity does consider both the mean and distribution of the performance data. Abandoning the standard statistical approach to performance measurement makes Zone Parity an *outcome*-based approach to performance measurement. In other words, failure to meet the specified quality standard is interpreted as a failure. Statistical approaches, on the other hand, are process-based measurement schemes. It is possible for a statistical test to be incorrect, indicating discriminatory service where service is in-parity when CLEC and ILEC processes are indeed identical or nondiscriminatory service when discrimination is in fact present when the ILEC process provides performance superior to that of the CLEC process. These mistakes are described as Type I and Type II error and have been the source of substantial debate in performance proceedings. Zone Parity, because it is outcome-based, requires no adjustment for Type I or Type II error.

The simple structure and interpretation of Zone Parity is an important improvement over statistical approaches to performance measurement. Statistical procedures, while routine and comprehensible to statisticians, are inordinately complex for the statistical layperson. Seemingly trivial assumptions about the properties of a statistical test can have enormous consequences in the measurement of performance. The requirement that every participant in the performance proceedings, including the regulatory commissions, retain a skilled statistician to actively participate is unreasonable. Those CLECs that cannot employ a near full-time statistician, or panel of statisticians to cover concurrent proceedings across multiple states, must put their fate in the hands of their rivals or potential rivals that can maintain a staff of statisticians. This situation is neither "just" nor "reasonable." Smaller CLECs are not the only entrants that are resource constrained. In Arizona, AT&T chose not participate in the performance plan proceedings because of a lack of resources.[5]

Additionally, Zone Parity is not plagued by a potentially serious shortcoming of the statistical approach to performance measurement. A statistical approach to performance measurement assumes that "nondiscriminatory" service (i.e., statistically identical) is also "just" and "reasonable" service. Put another way, the statistical approach considers only relative performance and not absolute performance. As long as the ILEC is providing the

[5] See letter from Richard S. Wolters, AT&T, to Maureen Scott dated July 27, 2000.

same level of service quality to itself and the CLECs, performance is deemed adequate under the statistical approach. Clearly, statistically identical service may be neither "just" nor "reasonable." If the ILEC's service quality is reduced the statistical approach will not detect it as long as everyone receive the same poor service. Zone Parity, alternatively, can detect absolute quality reductions and (as a consequence) allows regulators to balance the elements of the multidimensional standard of the Act.

The inability of the statistical approach to capture absolute performance is a serious shortcoming because CLECs are harmed relatively more than ILECs for a given "parity" reduction in the quality of service. The CLEC business plan relies on convincing customers to switch from the services of the ILEC to those of the CLEC. A customer chooses to patronize a CLEC based on the relative benefits of the CLEC and ILEC services and the cost of switching. Today, the ILEC provides service to virtually every customer, so the ILECs revenue source is not dependent on switching costs. Alternately, every customer of the CLEC must incur switching costs. Because disconnection and provisioning are fundamental elements of switching carriers, elements of the switching cost are affected by ILEC behavior. The lower the quality of disconnection and provisioning service, the greater the cost of switching. In turn, the greater the cost of switching, the less likely a consumer will choose to do so.[6] Because the cost of switching (or migration) is relevant only to the CLEC's ability to generate revenues, a statistical test approach to performance testing may conclude falsely that service is in parity when, in fact, it is discriminatory.

Benchmarks, including the Zone Parity Benchmarks, do not suffer from this flaw. By setting an absolute level of quality, the ILEC is unable to increase the costs of switching with a "parity" reduction in quality. The Zone Parity Benchmarks, because they are based on actual performance data, consider both the relative and absolute quality dimensions of performance. Absolute levels of quality are not new to the performance measurement debate; the concept already exists in benchmarks that account for roughly half of all performance measures.

2. SETTING THE ZONE PARITY BENCHMARK (INTERVAL MEASURES)

When an ILEC provides a service, whether to itself or to a CLEC, each observation of that service provision can be characterized according to a scale of quality. In this previous hypothetical example, the scale of quality is defined in terms of "time to repair" or "time to completion." For a given set of performance data the individual observations of the service provision can be grouped into categories along a quality scale. Within the context of Zone Parity, these groupings are called Zones and each Zone has a Zone Parity Benchmark that establishes the number or percentage of CLEC observations in each Zone that is consistent with "just, reasonable, and nondiscriminatory" service. The *Zone Parity Benchmark* consists of three categories of service provision: Zone 0, Zone 1, and Zone 2. These percentage benchmarks are *absolute* upper bounds; exceeding the benchmarks in Zone 1 or 2 by any amount is a failure to provide the established level of acceptable

[6] Let the utility of ILEC's and the CLEC's service be U service U', respectively. The cost of switching is C. A customer switch will occur only if $(U' - U - C) > 0$. Clearly, increases in C reduce the likelihood this relationship will hold.

service quality.[7] In this sense, the Zone Parity Benchmark is much like the benchmark measure common to existing performance plans. Zone Parity is not a radically new concept.

It is perhaps easiest to describe the zone benchmark approach by looking at some *hypothetical* data. Because the Act requires that the ILEC provide the CLEC service that is "... at least equal in quality to that provided by the local exchange carrier to itself or to any subsidiary, affiliate, or any other party to which the carrier provides interconnection (§251(c)(2)(C))", the Zone Parity Benchmarks can be established using historical ILEC or CLEC performance data. Actual data is evaluated in the next section. In Figure 1, we illustrate graphically a hypothetical set of ILEC data from the provision of "dialtone repair" service to itself (consistent with the earlier example).[8] The (hypothetical) distribution is not symmetric (it is lognormal), with 70 percent of the observations being smaller than the mean ($\bar{x}$), and 30 percent larger than the mean.[9] The data points lying above the mean can be split into two parts, the five percent of the largest observations (those above x^*) and the remaining observations lying between the mean and the five percent critical value (x^*).[10]

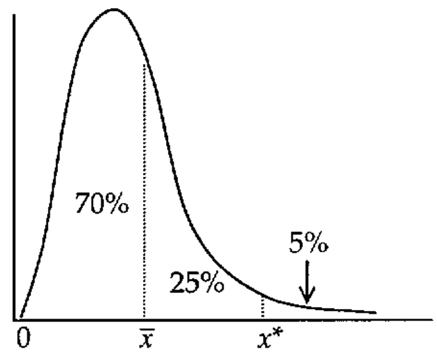

Figure 1.

This partitioning of the data produces three Zones. **Zone 0** includes all observations that are less than or equal to the mean of the actual data. **Zone 1** includes all observations that are above the mean but less than the critical value x^*. **Zone 2** includes the largest five percent of the observations and is bounded by x^* and $2x^*$.[11] Recall that the value x^* is set such that only five percent of the observations are allocated to Zone 2.

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[7] When these percentage benchmarks are multiplied by the number of CLEC observations, they become observation benchmarks.

[8] The distribution of observations illustrated in Figure 1 if purely hypothetical and for illustrative purposes only. When actually setting the Zone Parity Benchmarks, the values of the distribution - including $\bar{x}$, x^*, and the percent of observations in each Zone -- are derived from actual ILEC or CLEC data.

[9] Lognormal distributions are probably the most common distributional form of the performance measure data.

[10] Other percent values could be used to specify the critical value.

[11] An analysis of the actual data may indicate the upper boundary of Zone 2 could be greater or less than $2x^*$. However, the maximum acceptable quality of service should not be set too high. Quality service to consumers should be a priority and long intervals unacceptable, particularly in the case of few CLEC orders. Unlike the Zone Parity Benchmark, statistical testing does not allow a Public Service Commission to establish limits on acceptable levels of service.

Once the Zones are established (or bounded by $\bar{x}$, x^*, and $2x^*$), benchmarks are set for Zone 1 and Zone 2 that define the acceptable level of ILEC performance. The benchmarks are defined in terms of the "percent of observations" allowable in each Zone. These percentages are then multiplied by the total observations of a given CLEC resulting in an acceptable number of observations in each Zone.

For example, assume that the Zone Parity Benchmarks are set based on the hypothetical "time to repair" data previously discussed. As illustrated in Figure 2, for this hypothetical data the Zone 1 and Zone benchmarks are set at 25 percent and five percent, respectively.[12]

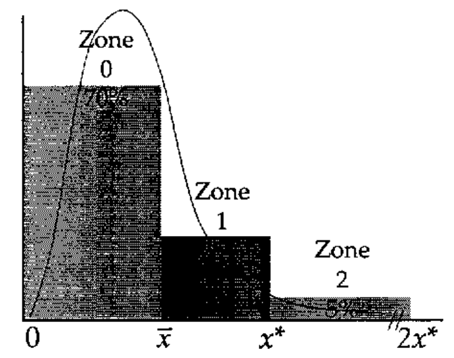

Figure 2.

The Zone Parity Benchmarks define the level of performance that meets the "just, reasonable, and nondiscriminatory" standard.[13] If the ILEC provides service within the bounds of the benchmarks, then no incentive payment is due. To reiterate the point made previously, Zone Parity is an output-based, rather than a process-based, performance measurement tool. If the ILEC provides worse than benchmark service to the ILEC during the specified measurement interval, the ILEC is "out of parity" and an incentive payment is prescribed. No consideration is given to the process from which the service provision data is generated because below benchmark service is harmful to the CLECs, consumers, and (consequently) the entire competitive process.[14] As such, worse than benchmark service, for whatever reason it occurs, is defined to be discriminatory and unreasonable.

Considering the outcome-based nature of Zone Parity, it is reasonable to allow for some "slack" in the benchmarks to account for small variations in service provision. Further, it may be necessary to adjust some of the benchmarks for seasonality. As discussed later, these adjustments can be easily accommodated with Zone Parity. It is important to keep in mind that "slack" relaxes the quality of service standard and that any reduction in

[12] Note in Figure 2 how the Zones mimic the actual distribution, albeit in a discrete fashion. Further, unlike the Z-test, the Parity Benchmarks consider properties of the distribution other than its mean and standard deviation such as skewness.

[13] Note the similarity between the current form of the benchmark and the Zone Parity Benchmark. In present day parlance, we would call the Zone Parity Benchmark a "stare-and-compare" benchmark approach (in this example) with 25 percent and 5 percent benchmarks.

[14] This conclusion is implicit in the definition of the benchmark.

service quality has the potential to harm consumers, CLECs, and impede the development of competition. A careful balancing of the "strictness" of the benchmark and its role of insuring quality service is required.
Again, note the similarities between the standard benchmark measure of other performance plans and Zone Parity. The benchmark measures in the other performance plans are typically "stare-and-compare" benchmarks just like the Zone Parity Benchmark. The basis for the stare-and-compare nature of benchmarks is that the benchmarks contain "fudge factors" or "slack," allowing for a modicum of variation in performance levels. This slack makes benchmarks limits, not targets. To perform statistical tests on established benchmarks, therefore, is double counting variation. Consistency with the earlier interpretations of benchmarks and the desire to avoid monthly statistical tests, therefore, requires that "slack" be added to the Zone Parity Benchmarks.

Adding Slack

The Zone Parity plan adds slack to the benchmarks in two ways. First, when the benchmarks are set from actual historical ILEC or CLEC data, a ten-percent slack factor is added to the observed percentages in each Zone. Under a ten-percent rule, the benchmarks for the above illustration would be 27.5 percent (25 + 2.5) for Zone 1 and 5.5 percent (5 + 0.5) for Zone 2. The "slacked" Zone Parity Benchmarks (ZPB) are illustrated in Figure 3.

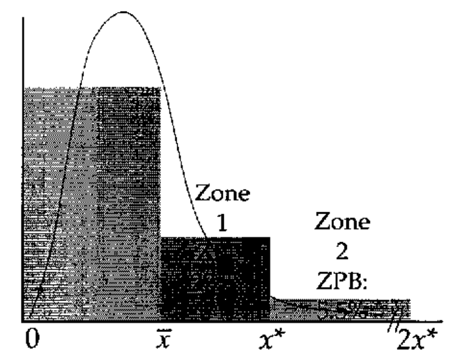

Figure 3.

Additional slack is incorporated into the Zone Parity Benchmark by adopting a "greatest integer" approach when calculating the number of benchmark observations. This greatest integer approach is particularly important for small order counts. For example, consider a CLEC with ten orders in a given month. Because the Zone 2 benchmark is 5.5 percent, then the acceptable number of CLEC observations in Zone 2 is 0.55 observations. Thus, if any of the CLEC orders are in Zone 2, a penalty is due. By adding slack through rounding, this one CLEC observation is within the bounds of benchmark (the next greatest integer of (0.05)(1+0.10) is 1). For this *small* sample, the ILEC is allowed two times (100%) the number of observations in Zone 2 than a "slackless" benchmark requires. Table 1 illustrates the magnitudes of slack for the five percent benchmark level across a range of sample sizes. Note that the addition of slack at a five percent benchmark level is very generous particularly for very small order counts. For order counts between five and one-hundred orders, the average percentage slack is 77 percent. Slack is never less than 10 percent of the benchmark.

Table 1.

CLEC Observations	*Observations at 5%Benchmark*	*Observations with Slack*	*Slack in 5% Benchmark*
5	0.25	1	300%
10	0.5	1	100%
20	1	2	100%
50	2.5	3	20%
100	5	6	20%
500	25	28	12%
1,000	50	55	10%
10,000	500	550	10%

Adjustments for Seasonality

For a few of the performance measures, the Zone Parity Benchmarks will need to be adjusted for seasonality or inclement weather.[15] The required adjustments for systematic changes in performance should be set *ex ante* using historical data. Whether the adjustments require shifting the distribution (i.e., the x's) or increasing slack should be determined by evaluating actual data. Seasonality adjustments should be made during the implementation (*ex ante*) phase and, as a consequence, will not complicate unnecessarily the monthly administration of the plan.

One possible method to adjust for seasonality is to shift the distribution by altering the x's by some pre-specified value. For example, in winter months, measurements capturing outside repair work may have the distribution shift by 10 percent so that the new Zone breakpoints are $1.1\bar{x}$ and $1.1x^*$. Alternately, the x's can remain the same, but slack can be increased. For example, an additional 10% slack can be added to the existing Zone Parity Benchmark. In either case, the adjustments for seasonality do not add much complexity to performance measurement. Generally, adjustments for seasonality should be restricted to "outside work" requiring manual intervention. Performance measures capturing electronic processes should not require seasonality adjustments.

Zone 2 Credits

In order to ensure that improvements in service are not penalized, any under-population of Zone 2 offsets over-population of Zone 1. For example, assume the Zone Parity Benchmarks are 27.5 for Zone 1 and 5.5 for Zone 2. A review of a CLEC's 100 orders reveals that 30 orders are in Zone 1 whereas none of its observations are in Zone 2. While the ILEC over populated Zone 1 by two observations, it under populated Zone 2 by 6 observations. The ILEC has, in effect, provided better than benchmark service for these 6 orders; the 6 Zone 2 observations received Zone 1 level service. In this scenario, the under-population of Zone 2 offsets the over-population of Zone 1 so that the ILEC satisfies the benchmark for both Zone 1 and Zone 2.

[15] Which measures are subject to seasonal variation can be determined from an analysis of historical data.

Absence of Historical ILEC Data

For measures where historical data is not available, or if historical service provision is simply below what is deemed by the State Commissions as "reasonable" service, the zone benchmark values must be determined by means similar to the determination of present day benchmarks (e.g., negotiation). Or, historical provision of service to CLECs might be used to set the Parity Benchmarks if that service has been acceptable.[16] Using CLEC data to establish benchmark levels is not prohibited by the Act. Ideally, we could use the observed properties of actual distributions from similar processes or a portfolio of processes to allocate observations to each zone. Certainly, information gathered over time should be used to improve the specification of the Parity Benchmarks.

Updating with Regulatory Lag

The Zone Parity Benchmarks can be updated as frequently as desired to account for improvements in service provision over time. Only improvements in service should be automatically incorporated in the benchmarks. The advantages and disadvantages to more or less frequent updates should be considered when specifying the update intervals. An evaluation of historical data may provide some indication of appropriate update intervals. Monthly monitoring of ILEC service data going forward also may indicate the appropriate update intervals. Further, some measures may warrant more frequent updates while others may warrant less frequent updates.

Including some lag in the update process may be desirable. By allowing the ILEC short intervals of better-than-benchmark service to itself, the ILEC may be incented to improve its processes. These improvements then are passed on to the CLECs in the near future when the benchmarks are adjusted. This lag in updating the benchmarks provides incentives similar to those provided by price-caps, where short-term profits lead the regulated firm to increase productivity. The benefits of the productivity are passed on to consumers (at some later date) when the productivity factor is applied and rates are recalculated. In fact, regulatory Commissions may choose to employ productivity factors as a basic feature of the Zone Parity approach.

Price-Quality Tradeoffs

Under Zone Parity, it also is possible for an individual CLEC to contract (subject to regulatory approval) with the ILEC for lower quality service in return for a discount on service rates (e.g., interconnection, non-recurring charges). This feature of Zone Parity is important. Competitive markets typically offer consumers a range of price-quality combinations and strict "parity" service restricts such options. An example of such price-quality tradeoffs is similar to the ability to purchase interruptible power from an electric utility. When CLEC data is aggregated, those CLECs that have negotiated different performance levels can either be removed from the sample or their observations can be scaled for consistency with the standard benchmarks.

[16] For current benchmark measures, the cutoff between Zone 0 and Zone 1 must be determined as well as the benchmark percentage of observations in Zone 1. If too costly to redefine the benchmark measures, then the current levels could remain implying that only Zone 2 failures are relevant.

3. SETTING THE ZONE PARITY BENCHMARK (PERCENT MEASURES)

For performance measures defined as percentages, the setting of Zone Parity Benchmarks is a bit different than for interval measures. Generally, percentage measures can be interpreted as success/failure rates. For example, how many orders were successfully completed in a specified interval? A hypothetical distribution for a percentage measure is illustrated in Figure 4 below. In this illustration, the about 60% of the measure pass and 40% fail the established standard. Depending on whether or not the measure is defined to capture the success or failure rate, the ILEC's performance will be 60% or 40% respectively.

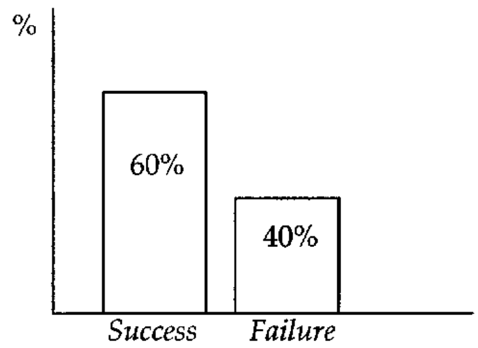

Figure 4.

For the percent measure, the Zone Parity Benchmark is a Zone 1 benchmark only. Following the basic logic of the Zone Parity Benchmark for interval measures, if P_I is the percent performance for the ILEC, the natural choice of the Zone Parity Benchmark is P_I. Adding 10% slack, the final Zone Parity Benchmark for percent measures is

$$ZPB_1 = P_I + 0.1 \cdot (W - P_I) \quad \text{if} \quad W = 1$$

$$ZPB_1 = P_I + 0.1 \cdot (W + P_I) \quad \text{if} \quad W = 0$$

where W is measures the best possible performance, i.e., either 0 or 1 depending on how the measure is defined.[17] To illustrate the Zone Parity Benchmark for percent measures, consider the following two examples. First, consider a measure that captures flow-through of electronic orders. In this case, 100% flow through is the best possible performance (by definition) so that $W = 1$. If the ILEC's performance level is $P_I = 0.90$, then the Zone Parity Benchmark is 0.91 [$= 0.9 + 0.1 \cdot (1 - 0.9)$]. Alternately, if the measure captures troubles (of some sort) per order, then the ideal outcome is zero trouble ($W = 0$). If the ILEC's performance level is $P_I = 0.1$, then the Zone Parity Benchmark is 0.11 [$= 0.1 + 0.1 \cdot (1 + 0.1)$].

4. AN EXAMPLE OF THE ZONE PARITY BENCHMARK (INTERVAL MEASURES)

To illustrate the interpretation of Zone Parity, assume that the CLEC has 100 orders of "repair service." The Zone Parity Benchmarks are 27.5 for Zone 1 and 5.5 for Zone 2 (28

[17] Note that this formulation of slack typically will increase the magnitude of "significant" means differences relative to the Texas-style calculations.

orders in Zone 1 and 6 orders in Zone 2 are acceptable under the benchmarks). Assume the observed CLEC data indicates that 35 observations are in Zone 1 and 10 observations are in Zone 2. In this hypothetical scenario, we would conclude that there are 7 observations too many in Zone 1 and 4 observations too many in Zone 2. How penalties are assessed on the missed benchmarks is discussed in Section III.

A few illustrations of the interpretation of Zone Parity are provided in Table 2. Note that the CLEC may have this same data in its own systems, so Zone Parity allows for CLECs to audit ILEC data. For Measure 1, the Zone 1 benchmark for 100 observations is 28 observations and the Zone 2 benchmark is 6 observations. Actual performance is observed to be 32 observations in Zone 1 and 10 observations in Zone 2. Both Zones are overpopulated by four observations each. For Measure 4, the benchmarks are met exactly.

Table 2.

Measure	*CLEC Orders*	*Benchmark Zone 1 (27.5%)*	*Benchmark Zone 2 (5.5%)*	*Actual Zone 1*	*Zone 1 (+ , -)*	*Actual Zone 2*	*Zone 2 (+ , -)*
1	100	28 Obs.	6 Obs.	32 Obs.	+4	10 Obs.	+4
2	100	28 Obs.	6 Obs.	30 Obs.	+2	4 Obs.	-2
3	100	28 Obs.	6 Obs.	25 Obs.	-3	6 Obs.	0
4	100	28 Obs.	6 Obs.	28 Obs.	0	6 Obs.	0

Obs. = Observations

Measure 2 in Table 2 illustrates how the under-population of Zone 2 can credit the over-population of Zone 1. For Measure 2, Zone 1 performance is two observations above the benchmark, but the ILEC satisfies the benchmark because it is below the Zone 2 benchmark by two observations. Because the over-population of Zone 1 is the result of the under-population of Zone 2, credit is given to the ILEC. For those two observations absent from Zone 2, better service was given by the ILEC than required and, as a consequence, no penalty should apply to those observations.

Note that credits are across Zones only and are not transferable across months (or whatever period is used to measure performance) or CLECs. The service standards of the plan are for a specified time interval (typically one month) and if the ILEC fails to meet the standard in that time period, then the CLEC has received below benchmark service for that interval.

5. An Illustration with Real World Data

In this section, the implementation and interpretation of Zone Parity is illustrated using actual CLEC and ILEC data on "Order Completion Intervals." To establish the Zones, we need to know the mean of the ILEC data and the critical value that cuts-off 5 percent of the tail. From a sample of 167,533 ILEC observations, the average order completion interval was 1,692 minutes (28 hours or about one day).[18] The completion interval that cuts-off the largest 8,376 observations (five percent of the total) is about 5,808 minutes (x^*; 97 hours or 4 days). About 71 percent of the total observations are below the mean. The remaining 29 percent of observations are split between Zone 1 with 24 percent and

[18] The standard deviation of the ILEC data is 3,237.

Zone 2 with five percent (by definition). The upper bound on Zone 2 is 11,616 ($2x^*$).[19] The Zone 1 benchmark (after ten percent slack is added) is 26.4 percent and the Zone 2 benchmark is 5.5 percent. All the Zone Parity Benchmarks are established; all that remains is to compare the CLEC data to these benchmarks.

For reference, the Zone Parity Benchmarks for the 167,533 ILEC observations were calculated using SAS. The calculations required only 6.1 seconds to complete.[20] Difficult, time-consuming calculations are not characteristic of Zone Parity.

Table 3 illustrates the performance differences between the ILEC and a number of CLECs. As just described, the Zone Parity Benchmarks are 26.4 percent for Zone 1 and 5.5 percent for Zone 2. These Parity Benchmark percentages are multiplied by the CLEC order count then rounded up to produce the benchmark number of observations for each Zone.

Table 3.

CLEC	*CLEC Orders*	*Zone 1 (26.4%)*			*Zone 2 (5.5%)*		
		Parity	Act.	+ -	**Parity**	Act.	+ -
1	337	**89**	111	+22	**19**	17	-2
2	131	**35**	21	-14	**8**	1	-7
3	56	**15**	6	-9	**4**	1	-3
4	37	**10**	10	0	**3**	0	-3
5	24	**7**	4	-3	**2**	0	-2
6	5	**2**	2	0	**1**	0	-1

PB: Parity Observations; Act.: Actual Observations

The examples presented in Table 2 show that the ILEC provides discriminatory service to CLEC 1; the ILEC's service in Zone 1 was above benchmark by 22 observations (111 – 89). The ILEC does, however, receive two credits from Zone 2 for a total of 20 observations above the Zone 1 benchmark. Overall, the ILEC is a nontrivial 6 percentage points above benchmark for CLEC 1 in Zone 1 [(111 - 2)/337 - 0.264]. The ILEC is below benchmark for all the other CLECs in the table.

Table 4.

CLEC	CLEC Mean	LCUG Z
1	1,927	1.34
2	1,233	-1.62
3	938	-1.34
4	1,132	-1.05
5	1,305	-0.54
6	2,251	0.38

Z Critical Value = 1.28 at $\alpha(0.10)$.

For comparison, the LCUG Z for each of the six CLECs is supplied in Table 4.[21] Note that the LCUG-Z indicates discriminatory service (at an α level of 10 percent) only for CLEC 1 – the same overall conclusion regarding discrimination as Zone Parity.

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[19] Only five of 983 total CLEC observations exceeded this value. Not all CLECs included in the data are presented in Table 2.

[20] The computer used was a 450Mhz Pentium III with 128MB Ram. Time is measured in SAS's "real time" not "cpu time." Improved programming may reduce the computation time.

[21] The LCUG Z values are from the simple LCUG Z formula, regardless of sample size, and are not based on permutation analysis.

6. An Illustration with Real World Data (Percent Measures)

Using an unspecified ILECs data on "repair repeat report rate" measure defined as a percent, the following ILEC mean-percentages are observed during August, September, and October: 19.49%, 19.05%, and 18.22%. The average of the three means is 18.92%.[22] A zero percent repeat rate is desired, so $W = 1$. Adding slack, the Zone Parity Benchmark is

$$ZPB_1 = 0.1892 + 0.1 \cdot (1 - 0.1892) = 0.2045$$

or 20.45%. Thus, any value exceeding 20.45% constitutes a failure of the Zone Parity Benchmark.

During October, the observed CLEC percentage was 20.69%, thus failing the Zone Parity Benchmark. Notably, the modified z-value was 1.97 indicating failure as well. As in the example above using interval measures, Zone Parity and the statistical approach produced similar results. For this particular measure, the number of Zone 1 failures under Zone Parity was 2.24 occurrences. In this case, the severity level was 0.011% (0.00236/0.2045), thus no severity factor was applied to the penalty. Using the Texas-style statistical approach, the failure rate was 0.40% and the number of occurrences equaled 1. It is not always the case, however, that Zone Parity will produce more occurrences than a Texas-style approach.

The Structure and Level of Remedies and Penalties

Because Zone Parity provides "counts" of discriminatory occurrences, a variety of remedy and penalty schemes are possible under this approach. Measuring the extent of discrimination as the number of above-benchmark observations makes linking the incentive payments, whether per-occurrence or per-measure, to severity a straightforward process. In the following text, a general outline of the penalty structure is provided. Of course, other structures are possible.

7. A Proposal for Penalty Structure

The purpose of a penalty payment is to extract the financial gain to the ILEC from deterring competitive entry by providing discriminatory service. In this section, the structure and size of the penalties is discussed. It is important to keep in mind that no matter how good the discrimination detection procedure is, remedies and penalties that are set too low will not induce the ILEC to provide just, reasonable, and nondiscriminatory service. Generally, *the size of the remedies and penalties should be sufficiently large so that the ILEC prefers to provide at least the benchmark quality of service rather than frustrating the competitive process by providing poor quality or discriminatory service.*

It is also important for decision makers to recognize that the ILEC will prefer to be completely free of financial liability. For the same reasons an ILEC has no incentive to offer CLECs quality service in the provision of unbundled elements (which is why a performance plan is needed in the first place), the ILEC has no incentive to propose a performance plan that encourages it to offer CLECs quality service in the provision of unbundled elements. Thus, any proposal by the ILEC regarding the level of penalties, or

[22] This is a simple average. The weighted average could be used in practice.

any aspect of the performance plan for that matter, should be viewed with a healthy degree of skepticism.

8. Economics and the Penalty Level

In a standard cost-benefit framework, an enforcement program will alter the benefits of non-compliance by extracting any gain to the regulated firm from the offending action through a fine or remedy.[23] For example, if the expected value of breaking a rule is \$50, then a fine of \$50 or more would make non-compliance an unprofitable action. This \$50 fine would be an effective deterrent, however, only if the regulated firm knows that it will be detected and punished with 100% certainty. If there is only a 50% probability of being detected *and* punished, then the expected value of the fine is only \$25 [i.e., $0.5 \cdot \$50 + (1 - 0.5) \cdot \$0$], which is well below the \$50 benefit from non-compliance. Thus, in this scenario, compliance is not expected.

Within the standard economic framework of crime and punishment, the optimal remedy for noncompliance is

$$F^* = \frac{\text{Increased Profits}}{\text{Probability of Detection}} = \frac{\delta\pi}{\phi} \tag{1}$$

where the optimal fine (F^*) is (at least) equal to the financial gain of non-compliance ($\delta\pi$) divided by the probability of being detected and punished for the particular violation (ϕ). If the firm expects to gain \$50 from non-compliance, and has a 50% chance of being detected and punished, then the optimal fine will be no less than \$100 (= \$50/0.50). For some fixed expected gain ($\delta\pi$), the optimal fine will be a declining function of the probability of detection (ϕ).

A Simple Example

Parking a car in downtown Washington, D.C., provides a simple but effective example of the economics of crime and punishment. Assume that an individual plans to be in a shop for about an hour. The car can be parked in a parking deck for \$5 an hour or free on the street. Street parking is forbidden, however, and a fine of \$20 is levied for the offense. If there is only a 20% probability of being ticketed for illegal parking, then a rational individual will choose to park illegally since the expected "cost" of doing so is less than the \$5 parking lot fee ($0.20 \cdot \$20 = \$4$). If the parking authority could increase the fine to \$30, however, illegal parking would be discouraged because the expected cost of doing so is \$6. Alternatively, holding the fine at \$20, the parking authority could hire more officers and increase the probability of detection. If the probability of detection and punishment can be increased to 50%, then the expected cost of illegal parking will be \$10 and the offensive activity deterred.

This simple parking example illustrates the fact that in order to establish a remedy structure that encourages individuals or firms to comply with particular rules of conduct, we need to approximate $\delta\pi$ and ϕ. Generally, we expect $\delta\pi > 0$ and $0 \leq \phi < 1$. If there is nothing to gain from non-compliance (i.e., $\delta\pi = 0$), then compliance is expected and no

[23] For a detailed exposition on the economics of crime and punishment, see Gary S. Becker, "Crime and Punishment: An Economic Approach," *Journal of Political Economy*, Vol. 76 (1968).

enforcement program is required. For a number of reasons, including the cost of implementation and administration, a perfect record of detection and punishment ($\phi = 1$) is an unrealistic expectation.

Intertemporal Gains

In the parking example, the cost and benefits of the illegal activity are action specific. That is, there are few long-term consequences associated with the offending action. In the context of performance standards for the ILECs, the exact opposite is true. In general, the expected benefits of discriminatory treatment against CLECs are neither case nor time specific. Rather, this discrimination would likely constitute a systematic attempt by the ILEC to slow the growth of competition in local exchange markets and to expand its own market share in long distance by disadvantaging its rivals. As a consequence, constructing punishment schemes on an occurrence specific basis will most likely be ineffective at deterring the discriminatory conduct of the ILECs.

Discrimination against CLECs provides three potential sources of economic gain for the ILEC. First, the customer may view the CLEC (or the aggregation of CLECs) as offering sub-standard service and decide not to switch to the CLEC and to remain a customer of the ILEC. In this case, the ILEC will reap not only the benefit of keeping the customer for a few extra days or months, but potentially many years. For example, assume that non-compliance with a particular rule allows an incumbent firm to keep a single customer from defecting to an actual or potential rival. For simplicity, also assume that this customer generates \$1 per month (\$12 per year) in profits for the regulated firm. The size of $\delta\pi$ depends, of course, on how long the incumbent will be able to keep the customer and extract that \$1 per month in profits. Assume that the non-compliant action ensures the incumbent will keep the customer for 5 more years. The discounted present value of the expected value of that customer over the next 5 years is \$45.50.[24] Thus, with 100% probability of detection and punishment, F^* is \$45.50 (\$45.50/1). If the probability of detection and punishment falls to 75%, then the optimal fine is \$61 (\$45.50/0.75). If the customer remains with the incumbent for 10 years, then F^* = \$98 (\$73.7/0.75).

The second potential source of economic gain for the ILEC is the systematic deterrence of competitive entry in the local exchange market. For example, assume that the non-compliant action of the incumbent diminished the good reputation of the actual or potential rival. As a consequence, this single act of non-compliance protects, say, ten customers from defecting to the rival. If each customer generates \$1 per month in profit, and remains with the incumbent for five years, then the optimal fine is \$455 if detection and punishment is certain. If the probability of detection is 0.75, the fine is \$607. What is important here is that the fine, while levied against a single act of discrimination, is based on the more widespread effects of the discriminatory act. In this simple example, a single act of discrimination is more appropriately viewed as ten acts of discrimination.

A simple figure helps illustrate the point. In Figure 2, the increase in CLEC market share in the local exchange market is measured along the vertical axis and time (t) is measured on the horizontal axis. If the ILEC provided parity service to the CLECs, then the growth in CLEC market share is measured by the line **0X**. Alternatively, if the ILEC discriminates in the quality of service provided to CLECs, the market share of rivals follows path **0Z**.[25] The benefit to the ILEC from discriminating against the CLEC can be measured at some arbitrarily chosen time in the future (say t^*). At t^*, if parity service is provided, CLEC market share has risen by an amount **0a**. If the ILEC discriminates against the CLEC, then the market becomes less conducive to competition and the CLECs gain only **0b** market share. In this case, the benefit to the ILEC of discrimination (at time t^*) against the CLEC is the financial value of the market share (**a** – **b**).

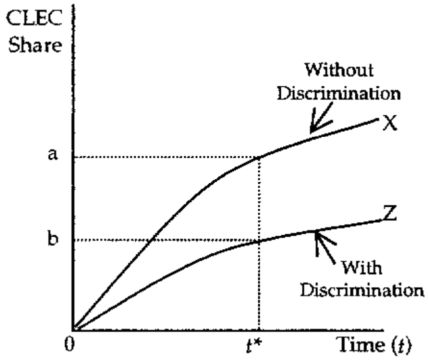

FIGURE 2.

Even if the discriminatory actions frustrate the competitive process only in the year in which the actions occur, the benefits are long lived. In Figure 3, the growth rate of CLEC market share with or without discrimination is assumed to be identical, but the growth in market share is postponed (or shifted) one year into the future. Again, the effects of a single year delay in competition are felt far into the future. At time t^*, for example, the ILEC receives the profits associated with (**a** – **c**) market share retained through discriminatory actions in Year 1.

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[24] Assumes an annuity of five-year length, a 10% discount rate compounded annually.

[25] With extremely poor performance, it is possible that CLECs will choose to exit the market so that CLEC market share actually declines over time rather than increasing at a slower rate than without discrimination.

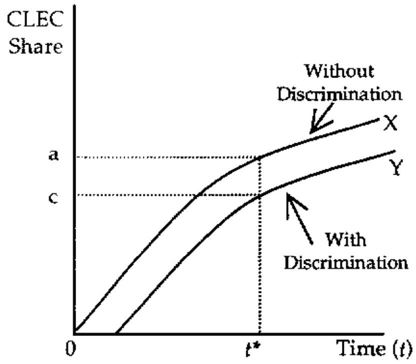

FIGURE 3.

As illustrated by the two figures above, providing poor service to CLECs in the earliest stages of competitive evolution, the ILEC may be able to extend the benefits of a few acts of discrimination to perhaps thousands of customers (or customer months). For example, assume a CLEC, attempting to assess the ability of the ILEC to provision customers, orders 100 loops in a single month. If the ILEC successfully provisions the loops in a reasonable time frame, then the CLEC may increase its order next month to 1,000 loops. If the service remains acceptable, then 10,000 loops may be ordered the next month. Continued quality service from the ILEC may eventually allow the CLEC to mass market its competitive local exchange service using television, radio, and print ads. With mass marketing, the CLEC may be able to increase its customer base by 100,000 loops in a given month.

This chain of events is broken, however, if the ILEC provides poor service to the CLEC on the first order of 100 loops. The CLEC, concerned about its reputation, will be reluctant to increase its loop orders by large amounts for fear of continued service problems. What could be an order of 100,000 loops in a few months shrivels into a few hundred. In the end, the ILEC will have retained thousands of customers by discriminating against fewer than one hundred. Under a case-specific enforcement approach, the ILEC will pay fines only for the twenty or so customers that received poor service in the first month. Yet, the economic gain from that discriminatory act was the profits from hundreds of thousands of customers.

A third source of financial reward for the ILEC is increased market share in the long distance and xDSL business. If the ILEC has received long distance entry approval under Section 271, then by reducing the quality of its rivals' local exchange services it may be able to acquire the local and long distance business of its rivals' disgruntled customers. Frustrating xDSL entrants with poor service may allow the ILEC to acquire market share in the high margin xDSL market at the expense of its rivals. Thus, in addition to remedies based on protected market share in local exchange services, the established remedies must be high enough to extract the full financial reward to the ILECs of gains in the long distance and xDSL markets acquired through discrimination against the ILECs' extant and potential rivals.

The gains in long distance and xDSL markets are not trivial. The potential gains to USW in the market for new services, such as long distance and DSL are sizeable. If we assume, for example, that the profit margin on the average long distance bill of $25 is approximately 20%, then the ILEC could increase its annual profit by $6.75 per customer acquired or retained by discrimination. Assuming a 38.5% profit margin on DSL service and an average price of $40, USW could increase its annual profit by $15.40 per customer acquired or retained by discrimination.[26] Across millions of access lines, the gains from discrimination in these markets can be substantial.

9. STRUCTURE

If discrimination is severe, the negative effects of the discrimination will not be restricted to the customers receiving the poor performance. Alternately, small deviations from parity may have only customer specific effects. Thus, both per-occurrence and per-measure penalties are appropriate. For small deviations from parity, only a per-occurrence penalty – reflecting the financial gain from a single customer -- should be levied. For larger deviations, per-measure penalties are more appropriate in that the penalty level will more accurately measure the true impact of the discrimination. In addition, small samples will never produce much in the way of penalties although discrimination against small samples may be a potent impediment to competition.[27] A simple (and conceptually appropriate) solution to this problem is to incorporate a per-measure penalty into the penalty structure.

Per-Occurrence Penalty

Because the output of Zone Parity is count data, a number of penalty structures are possible including both per-occurrence and per-measure penalties. A per-occurrence penalty structure is easily implemented, with a penalty of f for each above benchmark observation. For n above-benchmark observations, the per-occurrence penalty is nf. For example, consider the actual service provision data presented in Table 3. For CLEC 1, there are (a net) 20 above-benchmark observations in Zone 1. Thus, the total penalty will be $20f$ under a simple per-occurrence penalty structure. The Zone 2 penalty should be larger than the Zone 1 penalty, say $2f$. Thus, if there were a 10-observation overpopulation of Zone 2, the penalty would be $10{\cdot}2f$.

Per-Measure Penalty

Establishing a structure for the per-measure penalty is equally straightforward. The per-measure penalty will apply when an above-benchmark threshold is surpassed. For example, assume the per-measure threshold is set at 5 percentage points above the Zone benchmark (for either Zone 1 or Zone 2, though different per-measure penalties may apply to each zone). If the observed performance of the ILEC exceeds the 5 percent threshold across both Zone 1 and 2, then the per-measure penalty F will be added to the per-occurrence penalties (f in Zone 1 and $2f$ in Zone 2). As an example, consider the performance to CLEC 1 from Table 3. This level of performance would invoke a penalty of $F + 20f$, because the 20 above-benchmark observations in Zone 1 (adjusted for Zone 2 underpopulation) make the ILEC 6 percentage points above benchmark (128/337 = 0.38 versus 108/337 = 0.32).

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[26] Margin assumption is provided by *Broadband*, Stanford C. Bernstein & Co., Inc. and McKinsey & Company, Inc., Exhibit 63 (January 2000).

[27] Remember that the goal of the penalty is to extract the financial gain from the act of discrimination and that gain may not be highly correlated with sample size (especially for small samples).

Severity and Duration

Incorporating into the penalty structure adjustments for severity and duration is accomplished easily. A basic "factor approach" can be used. For example, a per-measure penalty of F is invoked at a 5 percentage point threshold; a per-measure penalty of $2F$ is invoked at a 10% threshold; $3F$ at a 15% threshold and so forth. These thresholds and penalty levels are hypothetical, but illustrate the simple way in which penalties for severity can be structured under Zone Parity.

Duration is another important dimension of discriminatory behavior. As with severity, a simple factor-based penalty structure can be designed to handle repetitive discrimination. As a theoretical matter, repetitious failure indicates that the penalty level is set too low. Thus, increasing the penalty in response to repetitious discrimination is appropriate. One potential penalty structure requires that when the per-measure penalty is invoked for two concurrent months, then the base per-measure penalty should be doubled (a factor of 2). In other words, exceeding the 5 percent threshold two months in a row increases the per-measure penalty of $2F$.

While the base penalty may be reduced back to F upon a few months of benchmark service, if the per-measure penalty is increased above the base level more than once (say, in a twelve month period), then the higher per-measure penalty should become the base penalty. Obviously, if this occurs, the base penalty is not adequate. If the higher penalty does not produce benchmark quality service, then the penalty will be doubled again (say, to $4F$). The goal is to set the penalty so that poor performance is not an acceptable option for the ILEC. Notice that the effective penalty (the one that ensures compliance) will be reached iteratively using the factor approach. The size of the factors and the initial base penalty will determine how much iteration is required to reach the effective penalty.

Table 5. Proposed Penalty Structure

Per-Occurrence Penalties					
	Observations > ZPB (Zone 1)		Observations > ZPB (Zone 2)		
	f		$2 \cdot f$		
Per-Measure Penalties					
Severity[†]	$\geq 1.05 \cdot ZPB$	$\geq 1.10 \cdot ZPB$	$\geq 1.15 \cdot ZPB$	$\geq 1.20 \cdot ZPB$	$\geq 1.25 \cdot ZPB$
Penalty	F	$2 \cdot F$	$3 \cdot F$	$4 \cdot F$	$5 \cdot F$
Duration[‡]	1 month	2 month	3 month	4 month	N month
Penalty	F	$2 \cdot F$	$3 \cdot F$	$4 \cdot F$	$N \cdot F$

[†] Severity penalties increase to $6 \cdot F$ at $1.30 \cdot ZPB$, and $7 \cdot F$ at $1.35 \cdot ZPB$, and so forth.

[‡] Duration factors return to 1 after 2 months of compliance. If duration factor exceeds 1 for a second time, then the increased penalty becomes the base penalty.

10. Initial Penalty Levels

In theory, the ILEC will choose not to discriminate if its expected financial gain from doing so is extracted by a penalty. Thus, in order to discourage discrimination, the financial gain must be estimated. If the penalty is below the financial gain, discrimination is profit maximizing and (as such) expected. If the initial penalty levels do not produce a benchmark level of quality, then the penalties are too low and should be increased.[28]

[28] See In the Matter of Bell Atlantic-New York Authorization Under Section 271 of the Communications Act to Provide In-Region InterLATA Service in the State of New York, Order, FCC 00-92 (March 9, 2000) and Order

The initial penalty levels are nothing more than "best guesses" of the financial gain from discrimination. Setting aside (for now) state specific calculations, a general framework for the "best guess" of the per-occurrence penalty (f) is set forth in the following text. Put simply, the financial gain from discrimination is the retention of profit. A single act of discrimination may allow the ILEC to retain the profit from that particular customer or all customers affected by that act. A single act of discrimination also may reduce the perceived quality of a CLEC or all CLECs, thus reducing the number of customers switching to a CLEC. The purpose of the per-occurrence penalty is to penalize the per-customer effects of discrimination whereas the per-measure penalty is intended to penalize the far-reaching implications of discriminatory conduct.
Generally, the per-occurrence penalties for Zone 2 failures should be based on the following formula:

$$2f = \frac{\pi \cdot A_{r,t}}{\phi} \tag{2}$$

where π is the annual profit protected by the act of discrimination and A is the present value of a \$1 annuity at discount rate r for t years, and ϕ is the probability of detection and punishment.[29] The numerator of Equation (2) is the expected profit from discrimination and is an estimate of the numerator in Equation (1). The relevant time horizon of the annuity (t) should equal to the expected number of years the customer will be retained by the ILEC because of the discriminatory performance. Recall that the Zone 2 penalty is twice the Zone 1 penalty. Thus, the per-occurrence penalty for Zone 1 failures is

$$f = \frac{1}{2} \cdot \frac{\pi \cdot A_{r,t}}{\phi} \tag{3}$$

which is equal to half the Zone 2 penalty. The Zone 1 penalty is below the full value of the expected gain because the failure is based on service quality that is better than Zone 2 quality.

The per-occurrence penalty can be specified as a percentage of total annual retail revenue for the ILEC service in question by rewriting Equation (2) as

$$f = R\left(\frac{m \cdot A_{r,t}}{2\phi}\right) = kR \tag{4}$$

where R is annual retail revenue for the ILEC for the service in question (e.g., POTS, xDSL, etc.), m is the profit margin on that service, and k is the term in parenthesis. The FCC's "Net Return" calculations from the NY 271 Order indicate a profit margin on local

Directing Market Adjustments And Amending Performance Assurance Plan, New York Public Service Commission Cases 00-C-0008 et al. (March 23, 2000).

[29] At a 10 percent discount rate and discounting annually, A is \$3.79 for 5 years and \$6.14 for 10 years. The FCC's "net return" calculation in the NY 271 Order indicates that the average margin (a reasonable measure of π) is about 25 percent. At this margin, annual revenues closely approximate the numerator of Equation (2) for a 5-year time horizon.

service of about 22 percent (although the return varies considerably by ILEC). Using the 22 percent margin, the per-occurrence penalties (f) – expressed as a percentage of annual retail revenues -- are provided in Table 6 for various assumptions regarding t and ϕ. [30]

Table 6. Zone 2 Per-Occurrence Penalties as a Percent of Annual Revenues (Margin = 0.22)

t (Years)	$A_{r,t}$ (r = 10%)	k (ϕ = 1.0)	k (ϕ = 0.75)	k (ϕ = 0.50)
1	0.91	20%	27%	40%
2	1.74	39%	51%	77%
3	2.49	55%	74%	110%
4	3.17	70%	94%	140%
5	3.79	84%	112%	168%
10	6.14	136%	181%	272%

The per-occurrence penalty is equal to k multiplied by total annual revenue for the service being "measured."

The table is interpreted as follows. Assume the annual revenues per switched access line are \$500 year. Setting r, t, and ϕ at 0.10, 1, and 0.75 (respectively), the per-occurrence penalty for measures affecting switched access lines would be \$133 (27 percent of \$500; numbers in table are rounded) for Zone 2 failures and \$67 for Zone 1 failures. Alternately, setting r, t, and ϕ at 0.10, 5, and 0.75 (respectively), the per-occurrence penalty for measures affecting switched access lines would be \$560 for a Zone 2 failure and \$280 for Zone 1 failure.

The revenue factor approach is a convenient method for establishing per-occurrence penalties. Per-occurrence penalties should not be identical across all measures, because a single per-occurrence penalty cannot accurately capture the expected financial gain from discrimination across a wide range of measures covering services of different revenues and profit margins. Because annual revenues are measured easily, establishing different per-occurrence penalties for different measures is not a difficult process.

Conceptually, the per-measure penalties should be computed using the formula

$$F = N \cdot \frac{\pi \cdot A_{r,t}}{2\phi} \tag{5}$$

where N is the number of customers indirectly affected by the discrimination.[31] Considering only those indirectly affected is appropriate because the profits from those directly affected are captured by the per-occurrence penalty. Equation (5) also can be rewritten for easier calculation. Letting w equal the number of customers indirectly affected by a single act of discrimination and n be the number directly affected, the per-measure penalty can be written as

$$F = w \cdot nf \tag{6}$$

[30] Equations (2) and (3) are based on the assumption that discrimination is an attempt to retain the customer and, therefore, the expected financial gain is based on retention. It seems reasonable to assume that retention is more likely with a Zone 2 failure than a Zone 1 failure. Implicit in the proposed calculation of the Zone 1 penalty is a 50% probability of retention.

[31] Because the per-measure penalty is invoked for both Zone 1 and Zone 2 failures, the Zone 1 penalty is used as a basis for the per-measure penalty.

where nf is the Zone 1 penalty multiplied by the number of above benchmark observations (in either Zone 1 or Zone 2). If w is equal to 1, for example, the per-measure penalty is equal to the sum of the per-occurrence penalties ($F = nf$). Equation (6) implies that the per-measure penalty will vary directly with the total per-occurrence penalty.[32] This relationship is sensible because severe discrimination experienced by a large number of consumers likely will have more widespread effects than severe discrimination against a few. This relationship, however, does not always hold. Discrimination that occurs early in the competitive process can have substantial negative effects despite low order counts. Because the per-measure penalty will be small for smaller samples (the n will be small), a minimum per-measure penalty should be established that applies to above threshold discrimination (i.e., severe discrimination) unless the value from Equation (6) exceeds this minimum penalty level.

In setting a value for w the relevant question is how many consumers are indirectly affected by a single act of discrimination (defined as above benchmark observations). Indirect effects of discrimination include scaling back entry efforts due to poor performance, reputation effects, word-of-mouth, and so forth. An initial value for w can be established by evaluating the FCC's penalties for slamming in the long distance industry. Using slamming penalties to establish a first approximation of w is sensible given that the FCC has found it reasonable to apply these penalties when a telecommunications firm interferes with a customer's decision to choose its telecommunications carrier (a situation all but identical to one dealt with in the performance plans). In June 2000, the FCC imposed a \$3.5 million dollar penalty on long distance carrier Worldcom for slamming. The penalty was based on 2,900 slamming complaints filed against the company during the year 1999. The per-complaint penalty approximately equals \$1,200. The average revenue per long distance subscriber is about \$300 annually (or \$25 per month). So that Table 6 can be used, assume that the long distance margin is 22 percent, which is consistent with estimates of the margin in the long distance business.[33] Further, assume that the typical customer life in the long distance industry is two years and that the probability of detecting and punishing slamming is 75 percent. From Table 6, the expected profit per customer from slamming is \$152.73 (0.51 multiplied by \$300). Assuming slamming is equivalent to a Zone 2 offense, the \$1,200 per-compliant penalty imposed by the FCC implies a value for w of 6.86:

$$\$1{,}200 \cong \$152.73 + 6.86 \cdot \$152.73. \tag{7}$$

A number of other proposals for penalties for slamming have w values as high as 261, 653, and 981.[34]

[32] In fact, absent the minimum per-measure penalty, the calculation described in Equation (6) implies that all penalties are "per-occurrence."

[33] For the average long distance bill, see George S. Ford, "An Economic Analysis of the FCC's Notice of Inquiry on Flat Rate Charges in the Long Distance Industry?," Table 1, filed in CC Docket No. 99-249, In the Matter of Low-Volume Long-Distance Users, Notice of Inquiry, July 20, 1999 (Average long distance bill = \$27.45). Assumed margin is taken from Communications Daily, SNET Said to Have Won 30% of IXC Business in Conn., GTE Gains Nationwide, December 3, 1996.

[34] See, e.g., Governor Pataki Introduces Bill To Halt Telephone Slamming, (June 18, 1997: www.state.ny.us/governor/press/june18_97.html) and Carolyn Hirschman, "Congress to Get Tough on Slammers," *Policy & Regulation* (July 27, 1998; www.internettelephony.com/archive/7.27.98/PRnews.htm).

Considering the enforcement experience against slamming, two approaches to setting w come to mind. First, the value for w could be set to 6.86 as calculated above. Alternately, the value of w could be set so that some predetermined specification of a severe failure (a slamming equivalent level of service) invokes a penalty of $1,200 per occurrence. Because Zone Parity produces counts of disparity, this latter approach easily is incorporated into the plan (unlike statistical approaches that do not produce disparity counts). Simulations can estimate the proper value of w given the choice of the time horizon and discount rate (from Table 6). For example, assume $A_{0.1,1}$ is the chosen specification for the annuity value (A). Also assume that the "slamming equivalent" disparity level is 100 percent (about 36 percentage points using the actual data summarized in Table 3 above) over the Zone Parity Benchmark. The estimated value for w using an average of ILEC data on revenue and profit margin per access line is 4. This estimate of w, of course, is highly dependent on a number of assumptions such as those in Tables 5 and 6 and should be computed for the Commission approved set of assumptions.

Review Threshold

For both the states of New York and Texas, the State Commission and the FCC approved remedy plans that included an annual cap on remedy amounts. In general, remedy caps are undesirable in that once the cap is reached, there is nothing to offset the incentives of the ILEC to provide disparate service unless the cap is raised (making the initial cap irrelevant) or other drastic remedial actions such as withdrawing interLATA authority or an antitrust suit. The presence of these more costly remedial measures does not justify designing failure into a performance plan. If the penalties are properly sized and levied, costly proceedings and lawsuits can be avoided.

A more desirable approach to overall penalty payments is to establish a review threshold. If an ILEC reaches the review threshold, then a proceeding is initiated to investigate the causes of such sizeable penalty payments. Unlike the cap, however, penalties are levied while this review is underway so the threat of penalties for poor performance is intact.[35] Further, the review threshold is not arbitrary allocated across months to limit monthly liability, as is the case in Texas.

Whether a cap or review threshold is included in the enforcement plan, the value of that threshold should be based on a sound economic analysis of the value to the ILEC of providing discriminatory service. The cap should not be set arbitrarily, as in the case of New York and Texas where no analysis was performed to evaluate the reasonableness of the proposed cap (set at 36% of "Net Return" as calculated by the FCC). The only evidence we have to date is that the 36% annual cap failed to provide sufficient incentive to Bell Atlantic – New York, requiring the FCC and New York Commission to raise the penalty cap. In the following section, a simple economic framework is developed to estimate the financial gain to an ILEC from impeding competition by providing discriminatory service (or no service at all).

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[35] Rather than halting penalty payments at the cap, the penalties should be increased if it is indeed poor performance that brought the ILEC to the cap. Obviously, if performance is so poor that the cap is reached, the penalties are too low.

11. ESTIMATING ANNUAL FINANCIAL LIABILITY

There are a number of conceivable methods that can produce estimates of the potential social cost and/or financial gain from discrimination. All of these methods require a number of assumptions. The requirement to make assumptions, some of which are more fact-based than others, should not deter us from doing so. Regardless of the enforcement scheme, the remedies must be sized. This task will either be methodological or arbitrary, the latter of which – by ignoring the basic economics of enforcement discussed above – offers little hope of effective enforcement. So that all parties can contribute to the debate and adjustments to the penalties can be made in the future as market conditions change, my estimation approach is clearly set forth in the following text. Because my estimation approach is rather straightforward, other scenarios are easily considered. It is important to realize that my chosen scenarios assume rather severe discrimination and, as a consequence, severe impacts. This assumption is compatible with the goal of determining either a review threshold or a cap. Only if the ILEC engages in severe discrimination will these liability limits be reached. As long as service is provided on reasonably non-discriminatory basis, actual remedies or penalties will be far below the review threshold.

12. ECONOMIC MODEL

In this economic model, financial liability is measured by the change in consumer welfare caused by discriminatory service where the effect of discriminatory service is less competition and, as a consequence, higher prices. For simplicity, I assume the demand curve takes the form $Q = S/p$, where Q is quantity demanded, p is market price, and S is market size (pQ; i.e., total revenue). The specification of the demand curve is isoelastic meaning the demand curve has constant unit elasticity.[36] Note that the estimates of financial liability using this demand model will be conservative because the elasticity of demand for telecommunications services typically is found to be less than one.[37] The change in consumer welfare for a price increase is maximized when demand is perfectly inelastic (a zero elasticity).[38] The choice of this demand model is based on the ease of computation, the available of data, and the conservative nature of the estimate.
For the isoelastic demand curve, the change in consumer welfare for a price change, which will include and consist primarily of the change in ILEC profit, is

$$\Delta CW = S \cdot \ln(p_h / p_l) \tag{8}$$

where the change in consumer welfare (CW) is equal to the market size multiplied by the natural log of the ratio of the higher price (p_h) to the lower price (p_l). The shaded area in the Figure 4 below illustrates the change in consumer welfare (or surplus) computed by the model.

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[36] Data for all three of these variables is available in ARMIS reports that can be downloaded at no charge from the FCC web site.

[37] See Lester D. Taylor, *Telecommunications Demand in Theory and Practice*, Kluwer Academic Publishers (1994).

[38] Changing the assumption to zero elasticity will increase the estimated financial liability by about 1.5%.

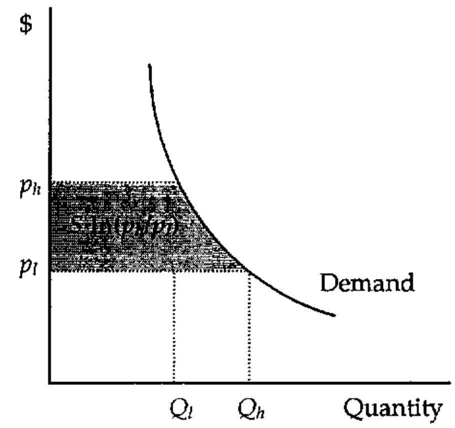

Figure 4.

For illustrative purposes, the financial liability for the average state (including areas served by the Regional Bell Operating Companies) is computed. Summing revenues from rows 5001 (Basic Area Revenue), 5060 (Other Local Exchanges), 5081 (End User), 5082 (Switched Access), and 5084 (State Access) from the 1999 ARMIS form 43-03, the market size for the average state is determined to be \$1.1 billion. All revenues included in the model are essentially revenues from local exchange and local access services; all toll revenues are excluded from the calculations. ARMIS form 43-08 indicates the average number of switched access lines was 2.9 million in 1999. Dividing revenues by lines produces an average revenue per line of \$38.19.[39]

As illustrated in Figures 2 and 3, discrimination has lasting effects, so a few assumptions about what happens over time are required. Access lines are assumed to grow exogenously (without respect to price) at 4.0% per year, which is the average growth rate of lines across all states over the time period 1995 to 1999. The discount rate is assumed to be 10%.

As a benchmark case, assume that without discrimination, the ILEC loses 3 percentage points of market share per year over the next 10 years. This share loss is roughly equivalent to the share loss of AT&T following divestiture where AT&T lost 30% market share over a 10-year period.[40] In this benchmark case, price is assumed to fall by 10% over the 10 year time period. This price change is based on the experience in the long distance industry and is roughly equivalent to \$0.13 per percentage point of market share (=0.10·38.19/30).[41]

While it is nearly impossible to get a precise estimate on the probability of detection and punishment, an assumption of 75% probability probably is conservative. As discussed previously, the adjustments for the probability of detection are required because no PAP

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[39] Note that market size and the percent price change are the primary determinants of financial liability, not average revenue per line. The natural log of the ratio of two numbers that differ by a constant percentage is a constant (it does not change with the absolute value of the numbers).

[40] According to the 1994/5 SOCC, Table 8.12, AT&T had a market share of 70% of presubscribed lines.

[41] This assumption is based on the reduction in long distance average revenue per minute (adjusted for access charge reductions) over the 10 years following divestiture. See Trends in Telephone Service, Tbls. 1.2, 14.6, and 14.7 (May 2000).

will achieve 100% detection and punishment. Ignoring the impossibility of capturing every potential form of discrimination in performance metrics, statistical testing alone can reduce the probability of detection to 75%. Dr. Collin Mallows has presented evidence that Type I and Type II errors are balanced (for actual ILEC performance data) at a critical value of 15%. Thus, statistical testing based on a critical value of 15% reduces the probability of detection by about 15% (the probability of Type II error).[42] For a critical significance (alpha) value of 5% (which is equal the probability of Type I error), Type II error will exceed 15% and alone could account for a 25% reduction in the probability of detection because decreases in Type I increase Type II error.

The effects of discrimination in my simulations are captured in market share loss and prices. In my first scenario, I assume that the ILEC blocks the growth of competition completely in Year 1 but CLECs resume the 3 percentage point annual growth in market share over the remainder of the time period. As shown in Attachment A, the estimated effective financial liability for the average ILEC in this scenario is $85 million that when adjusted for a 75% probability of detection and punishment is $114 million. Alternately, assume that discrimination postpones share loss in Year 1 as before, but increases to 2% for Years 2 and 3% thereafter. In other words, it takes some time for the competitive process to recover from the severe discrimination in Year 1. The estimated effective financial liability in this scenario is $110 million or $147 million adjusted for the probability of detection and punishment. The probability adjusted review thresholds are 33% and 42% of AM-IN's "Net Revenue" as calculated by the FCC's methodology set forth in the *BA-NY 271 Order* (See Attachment B for the FCC calculations). Note that the the higher of these two percentages of "Net Revenue" is consistent generally with the financial liability of Bell Atlantic New York after both the New York Commission and FCC's adjustments to the initial cap of 36% of "Net Revenue," raising the cap to 44% of net revenue.

13. LONG DISTANCE AND DATA SERVICES

It is important to note that the above-described scenarios include only profits from current services provided by the ILEC. Profits from long distance, DSL, and other new services are not included, demonstrating that my approach is conservative. The FCC in the *BA-NY 271 Order* noted that profits from these services are important in determining the review threshold. The FCC stated:

> While we are using net local revenue as a reference point or yardstick for comparison purposes, we do not suggest that local revenues constitute the only relevant figure. We recognize that Bell Atlantic may also derive benefits in other markets (such as long distance) from retaining local market share.[43]

Thus, any estimate of the review threshold based on local profits alone should be viewed as a lower bound of the threshold.

The potential gains to the ILEC in the market for new services, such as long distance and DSL are sizeable. If we assume, for example, that the profit margin on the average long distance bill of $25 is approximately 20%, then the ILEC could increase its annual profit

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[42] AT&T has performed a statistical analysis that suggests Type I and Type II error are balanced at 15%. At a alpha level of 0.15, the probability that the ILEC will discriminate and not be detected is approximately 15%. At smaller alpha levels, the probability of Type II increases.

[43] *BA-NY 271 Order*, n. 50.

by $10.5 million by increasing its market share through discrimination by only 1%.[44] Assuming a 38.5% profit margin on DSL service, where the monthly price for DSL is assumed to be $40, the ILEC could increase its annual profit by $5.3 million for every 1% market share it gains from discrimination.[45] Clearly, the gains from discrimination in these markets can be substantial.

14. FCC 271 ORDERS

In the *BA-NY 271 Order*,[46] the FCC indicated that BA-NY's proposed remedy cap was sufficient because it represented 36% of BA-NY's annual net income.[47] To my knowledge, no economic or financial analysis was performed by the FCC to support this figure. However, both MCI Worldcom and AT&T filed affidavits with the FCC asserting that the proposed remedy cap for BA-NY was too low.

The 36% of Net Income standard has proven ineffective in New York. The performance of BA-NY following its 271 approval demonstrates that the initial maximum remedy payment of 36% of net income was insufficient to ensure ongoing adequate performance by BA-NY, *despite of the initial findings of the New York Public Service Commission ("NYPSC") and the FCC.* As a result, the NYPSC and FCC raised the remedy payments in New York to a maximum potential liability of 44% of annual net income.[48] This 44% liability figure is more consistent with the analysis prepared by MCI WorldCom and AT&T as part of the BA-NY 271 proceeding, which recommended to the FCC that the minimum financial liability for BA-NY should be no less than 40% of net income.[49] I believe the recent modifications made by the NYPSC and the FCC support the use of economic and financial models to determine liability.

Conclusion

The purpose of this document is to outline the major features of the Zone Parity approach to performance measurement. This plan represents an alternative, non-statistical approach to

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[44] According to the ARMIS data (Report 43-08), the average number of switched access lines is 2.9 million as of December 1999. Multiplying 1% of the 2.9 million access lines by the long distance profit margin of $5 per month produces the increased profit figure of $145,661 per month, or about $1.7 million annually. For the average long distance bill, see George S. Ford, "An Economic Analysis of the FCC's Notice of Inquiry on Flat Rate Charges in the Long Distance Industry?," Table 1, filed in CC Docket No. 99-249, In the Matter of Low-Volume Long-Distance Users, Notice of Inquiry, July 20, 1999 (Average long distance bill = $27.45). Assumed margin is taken from Communications Daily, SNET Said to Have Won 30% of IXC Business in Conn., GTE Gains Nationwide, December 3, 1996.

[45] The calculation is $\$40 \cdot 0.385 \cdot 2.9 \cdot 12 \cdot 0.01 = 5.3$ million. Margin assumption is provided by *Broadband*, Stanford C. Bernstein & Co., Inc. and McKinsey & Company, Inc., Exhibit 63 (January 2000).

[46] See Application by Bell Atlantic New York for Authorization Under Section 271 of the Communications Act To Provide In-Region, InterLATA Service in the State of New York, Memorandum Opinion and Order, CC Docket No. 99-295 (rel. Dec. 22, 1999) ("BA-NY 271 Order").

[47] BA-NY 271 Order, ¶ 436.

[48] The NYPSC added an additional $34 million dollars to the original $269 million cap. *New York Market Adjustment Order.* In the *Consent Decree* between the FCC and BA-NY, a "voluntary contribution" of $3 million was assessed upon BA-NY with the potential for another $24 million if substandard performance continued. *See Consent Decree* at ¶¶ 16-17. It remains unclear whether or not the BA-NY PAP will be effective at the current, higher remedy payments.

[49] Joint Declaration of Dr. George S. Ford and Dr. John D. Jackson, CC Docket No. 99-295 at 16; and Affidavit of R. Glenn Hubbard and William H. Lehr on Behalf of AT&T Communications of New York, Inc., CC. Docket No. 99-295.

performance measurement that is easy to understand, provides a useful indicator of disparity that can be used to set penalties, and does not fail to detect absolute reductions in quality. Zone Parity promotes "just, reasonable, and nondiscriminatory" service provision through the use of quality of service standards that are both within the capabilities of the ILEC (satisfying parity) and of sufficient quality to facilitate the evolution of competition in local exchange telecommunications markets. Moreover, these service standards, based in many cases on observed ILEC performance, provide CLECs with certainty as to what level of service to expect from the ILECs and provides the ILECs with certainty as to the level of service required to avoid penalty payments.

Unlike statistical plans, designing effective penalty structures is straightforward with the Zone Parity approach to performance measurement. Duration and severity adjustments to the plan relax (somewhat) the necessity to be extremely accurate in setting initial penalty levels. If the initial values for penalties are set too low, the severity and duration adjustments to the per-measure penalties will (over time) bring the per-measure penalty level to its effective level.

Parts this document appeared as the joint work product of Drs. John D. Jackson and George S. Ford on behalf of MCI-Worldcom. This document is the sole responsibility of the author.

Attachment A. Calculation Details for the Average State

SCENARIO 1

Year	Switched Access Lines	Share Loss Benchmark	Share Loss Scenario	Price Benchmark	Price Scenario	ΔCW	ΔCW: Net Present Value (10%)
	2,913,221			$38.19	$38.19		
1	3,030,229	3.0%	0.0%	$37.80	$38.19	13,955,136	13,955,136
2	3,151,937	3.0%	3.0%	$37.42	$37.80	14,663,009	13,330,008
3	3,278,534	3.0%	3.0%	$37.04	$37.42	15,408,377	12,734,196
4	3,410,215	3.0%	3.0%	$36.66	$37.04	16,193,338	12,166,294
5	3,547,186	3.0%	3.0%	$36.28	$36.66	17,020,115	11,624,968
6	3,689,657	3.0%	3.0%	$35.89	$36.28	17,891,067	11,108,945
7	3,837,851	3.0%	3.0%	$35.51	$35.89	18,808,694	10,617,017
8	3,991,997	3.0%	3.0%	$35.13	$35.51	19,775,647	10,148,034
9	4,152,334	3.0%	3.0%	$34.75	$35.13	20,794,742	9,700,901
10	4,319,112	3.0%	3.0%	$34.37	$34.75	21,868,966	9,274,577
							114,660,075
				With 75% Probability Adjustment =			152,880,100

SCENARIO 2

Year	Switched Access Lines	Share Loss Benchmark	Share Loss Scenario	Price Benchmark	Price Scenario	ΔCW	ΔCW: Net Present Value (10%)
	2,913,221			$38.19	$38.19		
1	3,030,229	3.0%	0.0%	$37.80	$38.19	13,955,136	13,955,136
2	3,151,937	3.0%	2.0%	$37.42	$37.93	19,517,783	17,743,439
3	3,278,534	3.0%	3.0%	$37.04	$37.55	20,509,582	16,950,068
4	3,410,215	3.0%	3.0%	$36.66	$37.17	21,554,040	16,193,869
5	3,547,186	3.0%	3.0%	$36.28	$36.79	22,654,111	15,473,063
6	3,689,657	3.0%	3.0%	$35.89	$36.40	23,812,930	14,785,956
7	3,837,851	3.0%	3.0%	$35.51	$36.02	25,033,819	14,130,938
8	3,991,997	3.0%	3.0%	$35.13	$35.64	26,320,304	13,506,478
9	4,152,334	3.0%	3.0%	$34.75	$35.26	27,676,124	12,911,116
10	4,319,112	3.0%	3.0%	$34.37	$34.88	29,105,250	12,343,467
							147,993,529
				With 75% Probability Adjustment =			197,324,706